FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE

U S D A FOREST SERVICE
RESEARCH NOTE RM-161

ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

Cacodylic Acid Field Tested for Control of Mountain Pine Beetles in Ponderosa Pine

John F. Chansler,[1] Donn B. Cahill,[1] and Robert E. Stevens[2]

In an operational-scale field test, cacodylic acid (dimethylarsenic acid) was highly effective in preventing brood development of mountain pine beetle (Dendroctonus ponderosae Hopk.) in ponderosa pines (Pinus ponderosa Laws.) that had been infested about 2 weeks before treatment. Beetles infesting trees that had been treated with acid prior to the attack period were also unable to produce brood. Overall treating costs of $2 per tree were substantially lower than other direct-control methods. (KEY WORDS: Cacodylic acid, herbicides, insect control, Scolytidae, Dendroctonus ponderosae, Pinus ponderosa)

Cacodylic acid (dimethylarsenic acid), an herbicide, has shown promise in several recent experiments as a chemical control for bark beetles. A small-scale test by Chansler and Pierce[3] indicated it could cause satisfactory mortality against the mountain pine beetle (Dendroctonus ponderosae Hopk.) in ponderosa pine (Pinus ponderosa Laws.).

Introduced into the sap stream of a tree, cacodylic acid either kills beetles outright, makes the environment unsuitable for them, or both. Acid-treated green trees are attractive to beetles under certain conditions, and this characteristic has been used in attempts to reduce beetle populations by setting up fatal "attractant centers." Postflight applications, in which newly infested trees are treated, have also been tried.

The field test reported here was conducted in the northern Black Hills of South Dakota, about 10 miles southwest of Spearfish. The stand was primarily dense second-growth ponderosa pine about 90 years old, undergoing heavy attack by mountain pine beetles.

The objectives of the study were to:

1. Test a preflight acid treatment for its effectiveness in attracting beetles and killing them in place.
2. Test a postflight treatment in attacked trees for its effectiveness in killing beetles in place.
3. Obtain cost estimates for both treatments.

Methods

An area of about 5,000 acres known locally as Higgins Gulch was selected for a test site.

During the week of July 22, 1968, about 3 weeks prior to the normal mountain pine beetle mass attack period, 112 trees, mostly culls, were treated. These trees were then considered "pre-

[1] *Entomologists, Branch of Forest Pest Control, U. S. Dep. Agr., Forest Serv., Denver, Colorado 80225. Chansler is now located at the Division of Forest Pest Control, Northeastern Area, U. S. Dep. Agr., Forest Serv., Amherst, Mass. 01002.*

[2] *Principal Entomologist, Rocky Mountain Forest and Range Experiment Station, with central headquarters maintained at Fort Collins, in cooperation with Colorado State University.*

[3] *Chansler, John F., and Pierce, Donald A. Bark beetle mortality in trees injected with cacodylic acid (herbicide). J. Econ. Entomol. 59: 1357-1359. 1966.*

disposed" to attack. Treatment consisted of frilling the entire circumference of the tree trunk about 8 inches above groundline and applying full-strength Silvisar 510[4] from a squeeze bottle to the frilled area. About 2 ounces of material was used on each tree. Approximately 10 days after beetle flight, the area was carefully cruised and all successfully attacked trees found (895) were treated in the same manner as the predisposed trees. The results were checked briefly early in 1969, and were evaluated in detail on June 4 and 5. The final evaluation consisted of sampling typical trees throughout the treated area that received either of the two acid treatments, and several untreated but infested check trees. A series of six 6- by 6-inch bark samples was removed from each tree, one each from the north and south sides at (1) breast height, (2) 5 feet below the upper limit of the infestation, and (3) midway between the other two samples. Numbers of attacks, inches of egg gallery, and numbers of living insects were recorded from each sample. Diameter at breast height and the infested height of each tree were also recorded.

[4]*Trade name for a solution manufactured by the Ansul Company, Marinette, Wis., that contains the equivalent of 5.7 pounds of cacodylic acid per gallon. Trade names and company names are used for the benefit of the reader and do not imply endorsement or preferential treatment by the U. S. Department of Agriculture.*

Results

The results of both treatments are presented in table 1.

The preflight treatment, including $53 aircraft rental for detection purposes, cost just over $400, or about $3.60 per tree. Labor, mileage, and materials (acid) are included. The postflight treatment, involving a combined 100 percent cruise of the area and treatment of infested trees found, cost about $1,000, or about $1.15 per tree.

Discussion

Preflight Treatment

According to the crews making the postflight treatment, 85 percent of the trees that had been predisposed to attack were successfully attacked, and 66 percent of all subsequently attacked groups included predisposed trees.

In the final evaluation, we had difficulty distinguishing predisposed trees from infested trees treated after the mass attack, and in determining which of the predisposed trees had been successfully attacked. The trees we could identify were only attacked about one-half as heavily as green trees. We did not feel that these trees acted as especially efficient "attractant centers," but the experiment did not permit a quantitative evaluation of this factor. More study is needed before cacodylic

Table 1.--Effect of preflight and postflight cacodylic acid treatments against mountain pine beetles, South Dakota, 1968-69

Treatment	Sample trees			Mountain pine beetles			
	Size of sample	Average d.b.h.	Average height of beetle infestation	Average per square foot			Total live insects in sample
				Attacks	Length of egg gallery	Live insects	
	Number	Inches	Feet	Number	Inches	Number	Number
Preflight	8	11.5 ± 1.3	24.7 ± 9.7	4.4 ± 7.6	17 ± 18.4	0	0
Postflight	10	13.1 ± 2.1	24.3 ± 6.1	7.2 ± 4.2	47 ± 35.6	0.1	5
No treatment (Check)	4	14.6 ± 3.9	24.3 ± 4.7	7.0 ± 4.4	87 ± 37.6	72.5	435

acid can be considered useful as a beetle attractant in ponderosa pine. This study will need to center on such questions as timing, concentrations of the material, and distribution of treated trees.

Postflight Treatment

The postflight treatment was highly successful. Essentially no live insects were recovered from these trees, although attack density was comparable to that in untreated infested trees. Egg gallery length was substantially reduced, so total oviposition was presumably less. In most instances larval galleries had not been started, although a few larvae had progressed up to 1 inch before dying. Because this indicates the acid may be adequately transported some time after attack, more latitude may be available in timing the treatment. This will be investigated in future studies.

The number of check trees used to evaluate the results is admittedly small. Data from them are consistent with those generally obtained from normally infested trees, however, and are considered reliable. The fact that all or practically all insects were killed in both acid treatments made it unnecessary to account for differences in aspect or height of samples.

We conclude from the results that the acid treatment about 10 days following attack was highly effective in killing beetles. Similar results could probably be achieved elsewhere in the central Rockies where infestation conditions are comparable.

On the basis of this test, we feel that a series of carefully controlled pilot projects should be conducted against mountain pine beetles in ponderosa pine. Since cacodylic acid is properly registered for use as an herbicide, and its method of use here is similar, we see no unusual hazards. Until the application timing is further refined, treatments should probably be made within the period of 5 to 20 days following mass attack, which usually occurs about August 15 [5] in the Black Hills and central Rockies. Since timing in relation to the mass attack is especially important, a few infested trees in areas proposed for treatment should be caged and emergence noted to determine if the mass attack period is much different from normal.

Other aspects of a direct-control project, such as selection and layout of control areas and careful spotting to insure that all trees are treated, do not differ from those encountered with conventional treating methods. The limited time available for applying cacodylic acid is critical, and intensive preplanning will be required.

[5] *McCambridge, W. F. Emergence period of Black Hills beetles from ponderosa pine in the central Rocky Mountains. U. S. Forest Serv. Res. Note RM-32, 4 p., illus. 1964. (Rocky Mt. Forest and Range Exp. Sta., Ft. Collins, Colo. 80521)*

USE PESTICIDES CAREFULLY!

This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

Pesticides can be injurious to humans, domestic animals, desirable plants, honeybees and other pollinating insects, and fish or other wildlife---if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and their containers.

Agriculture --- CSU, Ft. Collins